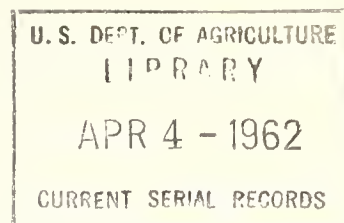


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HOG CHOLERA

A New Look at an Old Enemy

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Growth Through Agricultural Progress

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FOREWORD

Hog cholera, a deadly virus disease, has been killing swine in this country for nearly 130 years. It has appeared at one time or another in nearly every State where swine are raised and in many foreign countries. Some nations have eradicated hog cholera; the United States is living with it.

The fact that the United States is living with hog cholera means that our hog raisers are losing millions of dollars each year--because of swine killed by cholera, because of money spent for vaccines and serum to fight it, and because many cholera-free countries refuse to import pork raised in the United States.

But, while hog cholera is formidable, research and experience have established many facts about it. This report discusses some of these facts. It attempts to show that recent action by farmers, veterinarians, and others indicates a willingness to attack the problem with more vigor, and that many States have legislated against two common means of spread. It discusses the research and trial runs in this country and action programs in another country that employs the eradication approach. The report is primarily for agricultural leaders who have the opportunity of demonstrating that lessons learned about hog cholera and its control in one locality may be profitably applied in another.

Information in this report was provided by the Animal Disease Eradication Division and the Animal Disease and Parasite Research Division of the Agricultural Research Service

HOG CHOLERA

A New Look at an Old Enemy

Hog cholera, a deadly, worldwide, virus disease, kills more swine after weaning age in the United States each year than any other disease or condition. It costs U. S. hog producers between \$40 and \$60 million a year because of death losses and because of money spent for vaccines and serum to fight it.

Hog cholera restricts U. S. pork exports to about 69 million pounds a year when a potential foreign pork market of twice this figure actually exists. The primary reasons: Some foreign countries that import pork have eradicated hog cholera and so exclude United States pork because it might contain hog cholera virus. Other foreign countries that have hog cholera similarly exclude United States pork because they do not want any more of the disease introduced.

These direct and indirect losses are tolerated because hog cholera is tolerated--a situation that does not exist with our successful campaigns against tick fever of cattle, contagious pleuropneumonia, glanders, foot-and-mouth disease, vesicular exanthema, and the screwworm in the Southeast. These and other successful eradications exemplify established USDA policy--the policy of eradicating deadly, costly animal diseases when possible instead of living with them and trying to control them. State and Federal disease-control officials, practicing and research veterinarians, enlightened hog producers and others explain in the following way why our living with hog cholera has become more or less a habit:

1. Many of our hog raisers grew up with hog cholera. Their fathers suffered losses from it and so did their father's father. These generation-to-generation losses put the stamp of antiquity on the disease and induce the feeling that it has always been with us and always will be--that some losses from it are inevitable and natural. Besides being one of the deadliest animal diseases, hog cholera is one of the oldest established swine diseases in the United States.

2. Hog cholera is widespread. It is apparently an aborigine of the United States. The initial reportings of its presence came from southern Ohio in 1833. From Ohio, it subsequently spread to every State in the United States where swine are raised and to many foreign countries. It is therefore as universal as taxes and just as commonplace; some think it is too big to conquer, especially in a country as large as the United States.

3. Hog cholera presently occurs in cycles. Whether this is due to chance, to an intrinsic characteristic of the disease, to sporadic vaccinations, or all or combinations of these, has not been definitely established. In any event, enthusiasm for its prevention and control waxes and wanes as the cycles swell and subside. During low points in a cycle, hog raisers who do not vaccinate may sometimes suffer no losses. If the low point persists for several years, fewer and fewer raisers vaccinate, more and more pigs become susceptible, and no barriers exist to stop the disease

when it breaks out again, as it evitably does. (The number of pigs vaccinated in the United States steadily declined during the 10 years preceding 1961. During the first 5 months of 1961, the number vaccinated has increased.)

4. We have a reliable test for hog cholera, but it is time consuming. Many of its clinical signs mimic those of other diseases. How many swine it has insidiously killed without being suspected is difficult to estimate, but the fact that it does so must be another reason why it has persisted in this country since 1833.

But these same officials, veterinarians, hog producers, and others, all of whom are interested in keeping U. S. livestock healthy, have talked about eradicating hog cholera since the first experimental work on the disease began in 1850.

A Committee on the Nationwide Eradication of Hog Cholera, made up of members of the United States Livestock Sanitary Association, was organized in 1950. This committee presented its first report in 1951. Its recommendations led to the establishment of a pilot test area in Florida. More than 2,500 hog raisers have participated in this test program. As a measure of Florida's response to these tests, plans are now underway to extend the program over all the State.

Many other States are interested in similar programs. In fact, reports of the various States' activities against hog cholera are almost too numerous and varied for an immediate, accurate tabulation. Two significant developments, however, merit special mention. Thirty-eight States and Puerto Rico have restricted the use of virulent virus for vaccination (see p. 6) and most States require that garbage fed to swine be cooked (see p. 5). Thus, at least two doors through which hog cholera could spread are gradually closing.

The merit of these and other practices has been amply demonstrated in Canada, where hog cholera has been eradicated since 1910. In Canada, production costs per pig have been reduced and Canadian pork producers compete freely for foreign markets. In 1960, Canada reported that its hog cholera eradication for the past 45 years costs about $\frac{1}{2}$ cent per pig marketed. In the United States, the cost of vaccinating a pig is about 45 cents and U. S. producers still suffer death losses and other losses associated with the continued presence of hog cholera. Aside from these losses, this fact should also be considered: Domestic demand for pork promises to increase by 40 percent in the next 10 years. Any threat to the hog industry in any locality jeopardizes our chances of meeting this demand.

These and other developments that highlight current thinking about hog cholera in the United States prompt the publication of this report, which takes a new look at hog cholera--describing the disease, how it is spread, and how it can be prevented. The report also discusses some of today's immunizing and management practices that abet the disease and contribute to its spread and tenure in this country. The report is aimed at agricultural leaders everywhere who have the prime opportunity of helping to put many of its recommendations into practice.

THE DISEASE

Hog cholera occurs throughout the United States, but is most prevalent in areas where there are many swine. A few may be naturally immune, but from a practical viewpoint all swine in the United States that have not been immunized against hog cholera are susceptible to it--regardless of size, age, breed, color, sex, and the season of the year.

Hog cholera is infectious, contagious, and nearly always fatal--fewer than 5 percent of its victims survive. Two cubic centimeters of the virus (about one-third teaspoonful), diluted and divided, is enough to kill 3 million swine.

When a pig gets hog cholera, its blood, organs, and tissues soon seethe with the virus.

Every secretion or excretion from the pig (feces, urine, eye, mouth, or nose drippings, vomitus) may contain the live virus so that healthy pigs coming in contact with a sick one are soon infected.

A pig may have cholera from 4 days to 2 weeks without showing signs but during that time he is shedding the virus and may be infecting other pigs. By the time signs appear the herd may be beyond help.

If an infected pig is slaughtered before showing signs, his dressed carcass nonetheless carries the virus and remains a potential for spread until it is thoroughly cooked.

Diagnosing the Disease

Research workers, recognizing a need, are attempting to develop a more rapid method to confirm clinically diagnosed hog cholera.

Current laboratory aids in making a diagnosis include a total white blood cell count and a histological examination of the brain. The aids are not definitive, however, since other swine diseases cannot be ruled out by their application.

Absolute proof of hog cholera in the laboratory can be obtained by injecting a susceptible pig and an immune pig with macerated tissue from the suspected pig. If the susceptible dies and the immune lives, hog cholera is established. But the problem here is that it may take a week to get a diagnosis. However, after repeated observations, followed at times with laboratory confirmation, a trained diagnostician will recognize the disease. Canada encountered a diagnosing problem during its 1960-61 epidemic, but using the above procedures handled the problem quite effectively.

Swine are the only animals known to exhibit the signs and lesions of hog cholera, which rules out the use of mice, rats, guinea pigs, rabbits, or some other convenient animal for use in laboratory diagnosis.

Signs and lesions of hog cholera are identical with those of African swine fever* and are in many ways similar to those seen in swine erysipelas, septicemic salmonellosis, pasteurellosis, and streptococcosis. The presence of these or any other disease along with hog cholera may mask or pervert the signs normally induced by hog cholera. Only experienced veterinarians are qualified to determine accurately whether a pig or a herd has hog cholera. The signs of the disease, however, which appear below, may enable agricultural leaders to spot an infected pig or herd that would otherwise be unnoticed. If the signs appear in vaccinated herds, the need to notify a veterinarian promptly is doubly important because of the possibility that ASF might be present.

Signs of the Disease

The first sign that a pig may have hog cholera is a rise in temperature to 105° F. or higher. The temperature usually remains above normal (103° to 108° F.) until death is imminent and then drops abruptly to subnormal.

Following the temperature rise, the sick pig soon loses his appetite. He is inactive, "hides in his nest," or stands in a depressed, "thinking" attitude, and may have gummed eyelids. If he attempts to move, he sways and staggers, legs half bent, and usually collapses in any position. He may have fits or convulsions. His skin may also redden and a purplish discoloration may appear on ears and abdomen. He may have yellowish gray diarrhea after a day or so of sickness and the diarrhea often gets progressively worse. Cholera-sick pigs tend to pile on top of one another even in warm or hot weather.

Cholera-sick pigs appear to be sick "all over." In other words, they are usually unmistakably and severely ill, and they usually die or get better (they usually die) within 4 to 10 days after the signs first appear. These two characteristics--severity of signs and speedy approach to a crisis--show that hog cholera is an acute disease. Large swine such as old brood sows, however, frequently remain depressed and sick for 2 or 3 weeks before death. The initial or early cases in an infected herd frequently fail to show any lesions of hog cholera on post mortem, at which time no other animals in the herd may appear noticeably sick. There is a form of hog cholera that does not produce typical symptoms and deaths from it occur over an extended period of time.

HOW HOG CHOLERA SPREADS

Since hog cholera is highly contagious, eliminating or mitigating practices or conditions that contribute to its spread is essential in any preventive effort. Some of these conditions or practices prevalent enough in the United States today to be dangerous are:

1. The introduction of newly purchased, previously exposed feeder pigs into a susceptible herd without an adequate isolation period.

*African swine fever (ASF) is almost always 100-percent fatal. Once established in a herd, it spreads quickly by contact, the same as true hog cholera. ASF was first encountered in Africa in 1910, but was only mildly troublesome because of the relatively small number of hogs raised there. This disease, however, recently spread to Spain and Portugal. There are no guarantees that it will not spread to the rest of Europe and eventually to the United States. Once established in the United States, it would be an infinite menace because of the large numbers of swine raised here and because of the large movement of swine in transportation and commerce. If established here, it would also infinitely complicate any attempt to diagnose hog cholera.

2. Unvaccinated or improperly vaccinated pigs moving through public markets and then to farms as feeder pigs. In the Florida test area, at Live Oak, this practice contributed to a 50-percent increase in the incidence of hog cholera in a single year.

3. "Panic marketing." A typical example is this: One or two animals in a herd suddenly sicken and die. Rather than face the prospect of wholesale losses, the hog raiser loads his remaining, seemingly healthy, animals into a truck and takes them to market. If these have cholera, they become traveling sources of infection.

4. Transporting swine in contaminated trucks or other vehicles and penning or housing them in contaminated premises. The ability of hog cholera virus to survive outdoors and outside its host depends on the temperature--freezing tends to preserve the virus; heat to kill it. In experimentally contaminated manure water, it lived from 2 days to 7 weeks.

5. Improper disposal of cholera-killed swine. Dogs, crows, buzzards, and other animals and birds may carry the virus from such carcasses to cholera-free farms.

6. Feeding uncooked garbage. Virtually all uncooked garbage contains raw pork, and raw pork is very often loaded with hog cholera virus. The susceptible pig that eats pork scraps in uncooked garbage can be expected to develop hog cholera. This menace is not confined to commercial lots where garbage is fed almost exclusively, but may extend to farm lots when raw pork trimmings from the farm kitchen are carelessly thrown in "swill" destined for the hogs. The menace is also not confined to raw pork but includes some forms of processed pork. For example, hog cholera virus survives the process used to cure hams; bacon prepared from an infected animal caused cholera after 27 days; the virus lives for at least 73 days in the bone marrow of salted pork; and infected pork was capable of causing cholera after 1,598 days of refrigeration at -11° C. ($+14^{\circ}$ F.).

TREATMENTS AND PREVENTION

There is no cure for hog cholera. If an animal gets it, he will die unless he is one of the 5 percent or fewer that are naturally immune. Large doses of serum, injected into the exposed, unvaccinated in very early stages of the disease or before signs appear, may save some but not very many. Sulfa drugs and antibiotics may control secondary infections, but they have no effect on hog cholera--they merely prolong the infected hog's life. The inevitable outcome is almost always the same--death.

Keeping all swine vaccinated is the best precautionary measure that can be taken against this dreaded disease. Therefore, where hog cholera is suspected--and it should always be suspected even though it might not appear in any given year--the only safe thing to do is vaccinate. Experienced veterinarians know what to use and how to use it. They should always be consulted. But agricultural leaders may find the following information on immunizing agents valuable.

Anti-Hog-Cholera Serum

Anti-hog-cholera serum is made from the blood of hogs hyperimmunized by a special process that results in a high level of resistance to the

disease. The red blood cells are removed from the blood and the resulting liquid further processed. After successfully passing purity, safety, and potency tests, the serum is ready for sale and use.

Anti-hog-cholera serum instantly confers immunity from hog cholera and the immunity lasts generally for about 2 weeks to 3 weeks. Some reportings indicate that immunity induced by serum can last as long as 2 months.

Since the effects of serum are temporary, it is commonly used to meet emergencies--to protect susceptible, pregnant sows or pigs afflicted with some disease other than cholera that are too weak to tolerate a full vaccination. The use of serum alone as a general practice to produce temporary immunity in pigs destined for market should be discouraged because serum given before vaccines may block the action of the vaccines and the vaccinated pig may not develop immunity.

Virulent Virus With Anti-Hog-Cholera Serum

This method, simultaneously injecting virulent virus and anti-hog-cholera serum, was the only way of vaccinating hogs against hog cholera for many years. Without it, the huge swine industry in the United States probably could not have survived in the presence of hog cholera. The serum instantaneously protects the pig against the live virus until active resistance to the virus builds up in his body. Pigs vaccinated in this way, however, shed virulent virus and may infect other pigs and the premises they occupy. For this reason, the general use of virulent virus vaccines has been restricted in almost every State. Successful virulent virus-serum vaccination confers instant, lifetime immunity to hog cholera.

Modified Live Virus Vaccines

These vaccines opened a new approach to active immunization of pigs. They induce immunity with little danger of fully virulent virus being spread. Live virus is initially used in the preparation of these vaccines, but the virus is modified by passing it through nonhost animals--for example, rabbits, or other animal tissue cells. During these passages, the virulence (killing power) of the virus is drastically reduced, but its antigenic or immunizing properties are retained.

Modified live virus vaccines produce immunity within 4 to 7 days and the immunity may last for as long as 3 years, although yearly vaccination of breeding stock is recommended. Using serum with these vaccines instantly and fully protects pigs until the vaccine induces active resistance in the pig's body. The best time to vaccinate pigs is about 2 weeks after weaning. Pregnant sows should not be vaccinated with these vaccines. They should be vaccinated before they are bred.

Killed Virus Vaccines

These vaccines, made from live virus that has been killed by subjecting it to chemical treatment, must be used without anti-hog-cholera serum. They produce an active immunity lasting several months, but it takes upwards of 3 weeks for immunity to become established after successful vaccination. A second vaccination given 4 weeks following the first

acts as a booster similar to multiple vaccinations for polio. Results from multiple vaccinations have produced very satisfactory immunizations.

These vaccines should never be used on pigs that have been exposed to hog cholera. It is therefore important to know the status of all pigs newly purchased--have they been exposed to hog cholera? Have they been vaccinated? Have they received only serum?

Killed virus vaccines are entirely safe and can be used on pregnant sows and unthrifty pigs if the need is great. To get maximum immunity from killed virus vaccines, the pigs must be fully susceptible. Because immune sows pass along some resistance to their suckling pigs, at least 2 weeks should elapse after such pigs are weaned before they are vaccinated with killed virus vaccines.

MORE ABOUT VACCINES AND SERUM

Vaccines and serum are potent weapons in any fight against hog cholera, but they nonetheless have limitations. No vaccine has ever been 100 percent effective. Hog cholera vaccines, on the average, are between 85 percent and 95 percent effective. Thus, since no cure for hog cholera exists and no absolute preventive exists, the disease cannot be eradicated by vaccinating only.

Adverse Results

Pigs afflicted with anemia may develop shock following the administration of anti-hog-cholera serum.

Some otherwise normal pigs are uniquely susceptible to hog cholera and will acquire the disease easily when modified-live virus is injected into them, even though the same vaccine immunizes other pigs. No known way exists to identify the genuine hypersusceptible. Other causes of vaccination failure follow:

1. Concurrent infections (swine influenza, bacterial pneumonia, swine dysentery, malignant edema, swine pox, erysipelas, enteritis, rhinitis, and others) decrease a pig's ability to develop immunity.

2. Parasitic infestations, deficient or unbalanced rations, unsanitary housing conditions, or exposure to unfavorable weather have been known to negate vaccinations.

The Bright Side

Vaccines, however, are usually successful--if experienced veterinarians administer them to normal, disease-free pigs. This is a comforting, indisputable fact. When vaccines fail to immunize normal, disease-free pigs, the failures can usually be explained and the reasons for them corrected. For example, using vaccines that have been reconstituted for more than 24 hours, letting air get to the dried product, excessive dilution, transporting vaccines on a hot day in the trunk of an automobile without ice or refrigeration, using less than the recommended dosage--any, all, or combinations of these or other factors may cause immunization failures. At Live Oak, Fla., where the pilot test area is headquartered, immunity

protection, established by modified live virus vaccines, had gradually declined for about 4 years--typically from 83.3 percent in 1 year to 73.1 percent the following year. An investigation revealed that using "old" vaccine was one cause of this immunity decline. The Department of Agriculture is presently reviewing and reevaluating the expiration dates for modified live virus vaccines in the light of this information.

More Proof of Effectiveness

Studies at the Agricultural Research Service Hog Cholera Research Station, Ames, Iowa, include a 5-year field trial immunization of swine with crystal violet vaccine. (Crystal violet is one of the chemicals used in the preparation of so-called killed virus vaccines. The chemicals inactivate the disease-producing properties of the virus, but virus so treated is still capable of inducing immunity in the vaccinated pig.) About 15,000 pigs from 69 to 98 farms are vaccinated each year and between 4 percent and 5 percent of these are subsequently purchased and challenged with virulent virus. Although this field trial is not completed, no losses attributable to hog cholera have been observed in the experimental herds, even though neighboring herds frequently get the disease.

WHAT AGRICULTURAL LEADERS CAN DO

Agricultural leaders can help lower the incidence of hog cholera in the United States by (1) encouraging hog raisers to practice sanitation and general cleanliness around and in their hog lots, (2) urging more hog raisers to vaccinate their pigs with modified live virus vaccines and serum, (3) discouraging the use of virulent virus vaccinations, (4) discouraging the feeding of uncooked garbage, and (5) discouraging the serum-alone treatment except for pregnant sows and other pigs as discussed on page 6.

Why More Vaccinations

Since about 1953, the number of pigs vaccinated in the United States has gradually declined to 40 percent of the annual pig crop at the last reckoning. This is an invitation to disaster. Even though the incidence of hog cholera does not seem to be increasing at this time (we are presumably in a low point of a cycle), fewer barriers of immunized hogs exist to check the disease if it surges up again.

Feeder pigs should be vaccinated 3 weeks before they are moved to a public auction, public stockyard, interstate, or from farm to farm within a State. Disease-control authorities agree that this would do more toward stopping the spread of hog cholera than anything. Vaccination in transit is not a satisfactory substitute and will not solve the problem.

Increased vaccinations will stop potential outbreaks and constrain the disease at low levels, making it ideally vulnerable for application of other control procedures.

Serum-Alone Treatment

Pigs treated with serum alone and then later vaccinated with modified live virus and serum before the protective antibodies of the first serum

dissipate (about 30 days) may become susceptible to hog cholera within 6 weeks. In at least one instance, serum-alone pigs, later vaccinated with live virus and serum, died from hog cholera after about 8 weeks. This latter incident shows that preponderance of serum, not the type of vaccine that was used, prevents active immunization.

Pigs passing through sales barns in interstate movement are likely to receive serum alone. And records of their movements and treatments are often nonexistent. (If records do exist, they are often unreliable.) Thus, the degree of immunization the pigs possess at final destination is unknown. If vaccinated at final destination, permanent immunity may be inhibited, and hog cholera may still kill them if they are exposed. The unhappy climaxes to these incidents are (1) pig losses, (2) money wasted for vaccines, (3) the fact that the hog raisers who sustain the losses begin to question the efficacy of vaccines, and (4) the fact that animal disease experts may be betrayed into thinking that a variant virus is responsible for the losses.

SOME FINAL STEPS

The increased use of modified live virus vaccines and the fact that nearly all garbage fed to swine in the United States today is cooked are potent advances in the fight against hog cholera. As more and more hog raisers vaccinate, the incidence of the disease in the United States will surely go down. But Canadian experiences have proved that vaccination alone will never stamp out hog cholera. In Canada additional measures were necessary. Some of these are:

1. Controlled movement of infected or exposed swine. Hog cholera spreads easily enough through natural means. It is never conquered when transmitting pigs are moved about indiscriminately and the virus is literally broadcast over the countryside. Controlled movement can be accomplished by close unit community action and more formal regulations and quarantines.

2. Prompt reporting of infection. In any war, it is absolutely essential to know where the enemy is, and to make sure that he is properly identified. Time and money could be wasted following false leads.

3. Supervised disposal of cholera-killed swine, cholera-diseased swine, and disinfection of infected or exposed premises, vehicles, and equipment. These are commonsense precautions. The means by which cholera spreads are almost limitless. The ability of the virus to endure a harsh environment is legendary. To disinfect, use creosol. Thorough cleaning of pens and hog lots is essential before disinfecting.

PAST AND PRESENT

Research and followup legislation by the various States are steadily dispersing the 130-year-old cloud that hog cholera has cast over the swine industry in this country. Some significant developments follow:

1850--Hog cholera proved to be contagious.

1903--Causative agent isolated--the virus, Tortor suis.

1907--Development of anti-hog-cholera serum announced.

1908--Virulent virus-serum method of immunization proved effective.

1933--Tissue vaccine developed, killed-virus type.

1936--Crystal violet vaccine developed, also a killed-virus type.

1947--Nonvirulent live virus vaccine developed.

1949--Discovered variant hog cholera virus, which is now controlled in biologic production by preparation of frozen seed virus that must be tested for variant characteristics.

1950--U. S. Livestock Sanitary Association forms first committee to plan for eradication of hog cholera in the United States.

1953--Forty-six States require the cooking of garbage to be fed to swine. Although the high incidence of vesicular exanthema, and not hog cholera, prompted the garbage-cooking laws, their enactment apparently aided in reducing the incidence of hog cholera.

1954--Alabama outlaws the use of virulent virus for vaccination.

1960--Thirty-one other States have now outlawed the use of virulent virus for vaccination.

1961--Research continued at the ARS Hog Cholera Research Station, Ames, Iowa, to find, primarily, a satisfactory laboratory diagnostic test for hog cholera. The development of such a test would greatly simplify any campaign against the disease. The research station at Live Oak, Fla., continued studies on the effectiveness of vaccines, a matter of vital importance if the incidence of hog cholera in the United States is to be reduced.